

What is claimed is:

1. A biomolecule capture device comprising:
 - (a) a substrate having a surface;
 - (b) a maleic anhydride biomolecule-binding compound indirectly bound to the surface of the substrate, the maleic anhydride biomolecule-binding compound having a half life of binding of desired biomolecules of less than 1 hour; and a half life of release of desired biomolecules of less than 1 hour.
2. The biomolecule capture device of claim 1, the substrate comprising a polymer having exposed reactive sites on the surface.
3. The biomolecule capture device of claim 2, the substrate comprising one or more of polyamide, polyacrylamide, polyester, polycarbonate, polyethylene oxide, hydroxypropylmethylcellulose, polyvinylchloride, polymethylacrylate, polystyrene and copolymers of polystyrene, polyvinyl alcohol, polyacrylic acid, collagen, dextran, cellulose, calcium alginate, latex, polysulfone, agarose, aminohexyl agarose, aminododecyl agarose, and glass.
4. The biomolecule capture device of claim 2, the substrate comprising aminohexyl agarose or aminododecyl agarose.
5. The biomolecule capture device of claim 1, the maleic anhydride biomolecule-binding compound comprising a dialkyl maleic anhydride.
6. The biomolecule capture device of claim 1, the maleic anhydride biomolecule-binding compound comprising dimethyl maleic anhydride, methyl ethyl maleic anhydride, or diethyl maleic anhydride.
7. The biomolecule capture device of claim 1, comprising a solid support.
8. The biomolecule capture device of claim 1, the desired biomolecule comprising an amine containing compound.
9. The biomolecule capture device of claim 8, the amine containing compound comprising a protein.

10. The biomolecule capture device of claim 1, wherein the biomolecule-binding compound is covalently bound to a small molecule selected from the group consisting of biotin, hexa-histadine, hemagglutinin peptide, peptide, and flourous tag.

5 11. The biomolecule capture device of claim 1, further comprising a cognate of the small molecule of claim 10.

12. The biomolecule capture device of claim 11, wherein the cognate of the small molecule is selected from the group consisting of streptavidin, nickel, hemagglutinin peptide, an antibody selective for a peptide, and a flourous resin.

10 13. The biomolecule capture device of claim 1, wherein the cognate of the small molecule is attached either ionically or covalently to a support.

14. A method of removing and recovering desired biomolecules from a solution comprising the steps of

15 (a) contacting, under basic conditions, a solution containing one or more desired biomolecules with a biomolecule capture device comprising a substrate having a surface and one or more maleic anhydride biomolecule-binding compounds indirectly bound to the surface of the substrate;

(b) forming one or more reversible covalent bonds between the biomolecules and the biomolecule-binding compounds, wherein the half life of binding between the biomolecule-binding compounds and the desired biomolecules is less than 1 hour;

20 (c) washing the biomolecule capture device and biomolecules attached thereto to remove unwanted biomolecules;

25 (d) exposing the biomolecule capture device to acidic conditions, thereby reversing the covalent bond between the biomolecules and biomolecule-binding compounds thereby releasing the biomolecules from the biomolecule capture device, wherein the half life of release between the biomolecule-binding compounds and the desired biomolecules is less than 1 hour; and

(e) recovering the desired biomolecules.

15. The method of claim 14, the desired biomolecules comprising proteins.

16. The method of claim 14, the maleic anhydride biomolecule-binding compound comprising a dialkyl maleic anhydride.

17. The method of claim 14, the maleic anhydride biomolecule-binding compound comprising dimethyl maleic anhydride, methyl ethyl maleic anhydride, or diethyl maleic anhydride.

18. The method of claim 14, wherein the half life of binding between the biomolecule-binding compounds and the desired biomolecules is less than 30 minutes.

19. The method of claim 14, wherein the half life of release between the biomolecule-binding compounds and the desired biomolecules is less than 30 minutes.

20. The method of claim 14, the biomolecule capture device having a bead shape and is located in a column.

21. The method of claim 14, the desired biomolecule comprising an amine containing compound.

22. The method of claim 21, the amine containing compound comprising a protein.

23. A method of making a biomolecule capture device comprising:

(a) providing a substrate having one or more exposed reactive sites thereon;

(b) providing a dialkyl maleic anhydride;

(c) converting one alkyl group of the dialkyl maleic anhydride to a carboxyalkyl group;

(d) converting the carboxyalkyl group into a N-hydroxysuccinimidyl ester;

(e) contacting the dialkyl maleic anhydride with the substrate having the exposed reactive sites; and

(f) forming a covalent bond between the substrate and dialkyl maleic anhydride.

24. The method of claim 23, the substrate comprising the form of a bead.

25. The method of claim 23, wherein the substrate is on a solid support.

26. The method of claim 23, the substrate comprising one or more of polyamide, polyacrylamide, polyester, polycarbonate, polyethylene oxide,

hydroxypropylmethylcellulose, polyvinylchloride, polymethylacrylate, polystyrene and copolymers of polystyrene, polyvinyl alcohol, polyacrylic acid, collagen, dextran, cellulose, calcium alginate, latex, polysulfone, agarose, aminohexyl agarose, aminododecyl agarose, and glass.

5 27. The method of claim 23, the dialkyl maleic anhydride comprising dimethyl maleic anhydride, methyl ethyl maleic anhydride, or diethyl maleic anhydride.

28. A biomolecule capture device comprising:

(a) a substrate having a surface;

10 (b) a dialkyl maleic anhydride biomolecule-binding compound indirectly bound to the surface of the substrate.

29. The biomolecule capture device of claim 28, the substrate comprising aminohexyl agarose or aminododecyl agarose.

30. The biomolecule capture device of claim 28, the dialkyl maleic anhydride biomolecule-binding compound comprising dimethyl maleic anhydride, methyl ethyl
15 maleic anhydride, or diethyl maleic anhydride.

31. The biomolecule capture device of claim 28, the substrate comprising a polymer having exposed reactive sites on the surface.

32. The biomolecule capture device of claim 28, the substrate comprising one or more of polyamide, polyacrylamide, polyester, polycarbonate, polyethylene oxide,
20 hydroxypropylmethylcellulose, polyvinylchloride, polymethylacrylate, polystyrene and copolymers of polystyrene, polyvinyl alcohol, polyacrylic acid, collagen, dextran, cellulose, calcium alginate, latex, polysulfone, agarose, aminohexyl agarose, aminododecyl agarose, and glass.